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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/714,207	11/14/2003	Yuan-Hung Chiu	TS03-442	2547

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EXAMINER	
TRINH, MICHAEL MANH	
ART UNIT	PAPER NUMBER
2822	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/25/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/714,207	CHIU ET AL.	
	Examiner	Art Unit	
	Michael Trinh	2822	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *30 October 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2 and 5-10* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2 and 5-10* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

*** This office action is in response to Applicant's Amendment/Response filed October 30, 2006. Claims 1-2,5-10 are pending. Claims 3-4,11-39 were canceled.

*** The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claim Rejections - 35 USC § 102 and/or 103

1. Claims 1,5 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Yeh et al (6,207,565).

Under 35 USC 102 rejection: Yeh et al teach (at Fig 9, col 6, lines 38-67; col 7, lines 1-47; col 5, lines 50-67; col 4, lines 28 through col 5; Figs 1-8 and related text) an integrated process flow involving a patterned photoresist layer 208 on a substrate 102 in an etching tool that has one or more process chambers, said patterned photoresist layer 208 having an opening with a top and bottom that extends through at least one underlying layer 104 in said substrate 102, comprising: (a) performing an oxygen plasma ashing step to remove said patterned photoresist layer 208 (Figs 9, col 6, lines 47-55; col 2, lines 38-54; col 1, lines 35-53); (b) cleaning a residue from the opening by performing a halogen containing plasma step, in which oxide etch by using a dry plasma etch, such as CF_4, to remove the oxide that grew onto the semiconductor substrate (col 6, lines 56 through col 7; Fig 9; col 2, lines 38-54; col 1, lines 35-53) ; and (c) after dry plasma etch to clean the residues, etching the cleaned opening in the substrate by performing a CF_4/H_2O plasma in the substrate (col 6, line 64 through col 7; col 6, lines 38-67; col 7, lines 1-47; col 5, lines 50-67; col 4, lines 28 through col 5,), wherein an inductively-coupled plasma chamber of the Mattson Aspen ashing system (col 7, lines 17-32; and col 5, lines 39-67, col 6, lines 38-67, col 7, lines 1-47; Figs 1-9) is mentioned and employed for carried out the invention, wherein Yeh teaches (at Table I, Figure 6; col 4, lines 28-67) the steps (a), (b), and (c) are performed in the same process plasma chamber of the etching tool by introducing or stopping of the plasma into the same inductively-coupled plasma chamber of the Mattson Aspen ashing system, and thereby apply the same to carry out the process steps as recited in Figure 9. Re claim 5, wherein the halogen containing plasma step involves a plasma of CF_4, CHF_3, C_2F_6, which plasma satisfies $C_xF_yH_z$ where x and y are integers and z is an integer or is 0 (col 6, lines 56-63; col 7, lines 7, lines 22-25).

In the alternative as under 35 USC 103 rejection: Yeh teaches a method as applied above to claims 1 and 5, and fully repeated herein. Although Figure 9 of Yeh does not state "steps (a), (b), and (c) are performed in the same process chamber of the etching tool" as recited in claim 1. However, Figure 6 of the same Yeh clearly teaches (at Table I; col 4, line 28 through col 5) performing the steps (a), (b), and (c) in the same plasma process chamber of the etching tool by simply introducing or stopping of the plasma into the same inductively-coupled plasma chamber of the Mattson Aspen ashing system (see Table I, Figure 6, and col 5, lines 50-67, col 6, lines 47-67; col 4, lines 28 through col 5), wherein the inductively-coupled plasma chamber of the Mattson Aspen ashing system is used for carrying out of the invention of as shown in Figure 9, Figure 6, and Figures 1-5. Therefore, the subject matter as a whole would have been obvious to one of ordinary skill in the art at the time the invention was made to carry out and perform the steps as shown in Figure 9 of Yeh by performing the steps (a), (b), and (c) in the same process chamber of the etching tool by introducing or stopping of the plasma by using the same inductively-coupled plasma chamber of the Mattson Aspen ashing system, as disclosed the same by Yeh. This is at least because of the desirability to reduce production and equipment cost since only the same single inductively-coupled plasma chamber of the Mattson Aspen ashing system, and because of the desirability to allow a number of steps to be performed in the same plasma chamber, less expensive, wherein manufacturing of an electronic device is simpler since only a single tool is needed for performing a number of steps.

Claim Rejections - 35 USC § 103

2. Claims 1,5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al (6,025,273) in view of Yeh et al (6,207,565) and Yang et al (6,221,772).

Chen teaches an integrated process flow involving a patterned photoresist layer 18 on a substrate 12/10 in an etching tool that has one or more process chambers, said patterned photoresist layer 18 having an opening with a top and bottom that extends through at least one underlying layer 16 in said substrate, comprising: (a) performing an oxygen ashing step to remove said patterned photoresist layer 18 (Figs 3-4; col 4, lines 51-65); and (c) etching the opening in the substrate to transfer the opening through an exposed layer at the bottom of the opening in said substrate (Fig 5, col 5, lines 1-20). Re claim 5, wherein said halogen containing

plasma step involves a plasma of CF_4, CHF_3, C_2F_6, which plasma satisfies $C_xF_yH_z$, where x and y are integers and z is an integer or is 0 (col 4, lines 64 through col 5, line 5). Chen also teaches (at col 4, lines 55-67) the etching tool including reactive ion etching (RIE) or a HDP etcher.

Re claim 1, Chen lacks cleaning a residue from the opening by performing a halogen containing plasma after oxygen ashing to remove the photoresist layer, and lacks mentioning to perform the steps in the same process chamber of the etching tool.

However, Yeh teaches (at col 6, lines 38 through col 7; Fig 9; col 2, lines 38-54; col 1, lines 35-53) cleaning to remove residues from the opening by performing a halogen containing plasma after oxygen ashing to remove the photoresist layer, since residues are existed on the substrate. Yeh also teaches, at Table I of Figure 6 (Figure 9, col 6, lines 47-67, col 7, col 5, lines 50-67), the steps (a), (b), and (c) are performed in the same process chamber of the etching tool by introducing or stopping of the plasma (see Table I, Figure 6) into the inductively-coupled plasma chamber of the Mattson Aspen ashing system, in which Yeh teaches after performing an oxyen plasma ashing to remove the photoresist, performing a halogen plasma etching step to clean residue, and performing a plasma etching to the cleaned opening, wherein the same single inductively-coupled plasma chamber is used for ashing and etching. Yang et al also teaches (at Figs 5-8; col 3, line 10 through col 4, line 26) performing in-situ plasma ashing steps and in-situ plasma etching steps in the same process chamber of the etching tool (col 4, lines 6-18; and col 3, line 39 through col 4, line 26).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to fabricate the semiconductor process flow involving a patterned photoresist layer of Chen by performing a halogen containing plasma to clean and remove residues from the opening after oxygen ashing to remove the photoresist layer, as taught by Yeh. This is because of the desirability to clean and remove residues from the substrate. This is also because of the desirability to prepare a semiconductor substrate which does not allow residues to become trapped on the semiconductor substrate so that other subsequent processes can be surely carried out in a reliable manner, thereby a high quality semiconductor device can be effectively manufactured. Additionally, it would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the steps of oxygen ashing, halogen plasma, and etching opening of Chen by using the same plasma process chamber of the etching tool, as taught by Yeh

and Yang above. This is at least because of the desirability to allow a number of steps to be performed in the same plasma chamber, less expensive, and reduce production and equipment cost, wherein manufacturing of an electronic device is simpler since only a single tool is needed for performing a number of steps.

3. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al (6,025,273) and Yeh et al (6,207,565) and Yang et al (6,221,772), as applied to claims 1,5 above, taken with Shan et al (6,232,236) and Levenson et al (2001/0038089).

The references including Chen and Yeh teach an integrated process flow involving a patterned photoresist layer 18 as applied to claims 1 and 5 above.

Re claim 2, the references including Chen lacks listing etching tool being a split power etcher, a dual power etcher, a single power etch tool, a reactive ion etcher, or a conventional barrel, direct, or downstream type of ashing tool.

However, Shan teaches (at col 5, lines 11-29; col 3, lines 46-55; col 4, lines 15-35) etching tool including a split power etcher, a dual power etcher, a single power etch tool, a reactive ion etcher. Levenson teaches (at col 4, paragraph 46; paragraphs 5-12) plasma ashing tool including down flow, barrel, direct, and downstream type of ashing tool. Chen also teaches (at col 4, lines 55-67) the etching tool including reactive ion etching (RIE) or a HDP etcher.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the oxygen ashing and halogen plasma step of Chen by employing the etching tool of a split power etcher, a dual power etcher, a single power etch tool, a reactive ion etcher, or a barrel, direct, or downstream type of ashing tool, as taught by Shan and Levenson. This is because these tools are alternative and art recognized equivalent tools so that the plasma ashing and etching steps can be effectively performed in a reliable manner.

4. Claim 5-6 are further rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al (6,025,273), Yeh et al (6,207,565) and Yang et al (6,221,772), as applied to claims 1,5 above, taken with Hayasaka et al (5,298,112) and Hori et al (5,411,631).

The references including Chen, Yeh, and Yang teach an integrated process flow involving a patterned photoresist layer 18 as applied to claims 1 and 5 above. Re claims 5-6,

Chen already teaches (at col 4, lines 58 through col 5, line 5) halogen containing plasma including Cl_2, HBr, CF_4.

The references including Chen do not list all halogen plasma as recited in claim 5, the plasma includes CF_4, CH_2F_2, SF_6, NF_3, Cl_2 and $C_xF_yH_z$ where x and y are integers and z is an integer or is 0; and Re claim 6, HBr is included in combination with the above halogen plasma.

However, Hori teaches (at col 5, lines 36-54) halogen containing plasma including CF_4, NF3, SF_6, Cl_2, CHF_3, in which $C_xF_yH_z$ where x and y are integers and z is an integer or is 0, wherein HBr is included in combination with the plasma including Cl_2. Chen already teaches (at col 4, lines 58 through col 5, line 5) halogen containing plasma including Cl_2, HBr, CF_4.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the halogen containing plasma step of Chen by employing available known halogen containing plasma including of CF_4, CH_2F_2, SF_6, NF_3, Cl_2 and $C_xF_yH_z$ where x and y are integers and z is an integer or is 0, with HBr included in the halogen plasma, as taught by Hori and Chen. This is because these halogen containing plasma are alternative and art recognized equivalent plasma etchants so that unwanted residues and material can be effectively removed from the substrate in a reliable manner.

5. Claims 7-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al (6,025,273), Yeh et al (6,207,565) and Yang et al (6,221,772), as applied to claims 1,5 above, taken with Webb et al (5,228,950).

The references including Chen, Yeh, and Yang teach an integrated process flow involving a patterned photoresist layer 18 as applied to claims 1 and 5 above.

Re claims 7-8, Chen already teaches (at col 4, lines 55-67) using reactive ion etching (RIE) or a HDP etcher for performing the halogen containing plasma step, but lacks detail about process parameters of flow rate, pressure, temperature, power, time period, as recited in claims 7-8.

However, Yeh also teaches (at Fig 6, Table I, Step 2) performing a halogen containing plasma step, with a gas flow rate of about 360 standard cubic centimeters per minute (sccm), a chamber pressure about 0.5 Torr, a chamber temperature of about 250 degree C, a RF power of about 975 Watts, and for a period of less than about 2 seconds. Webb teaches (at col 3, line 9

through col 4, lines 60) performing a NH_3-halogen containing plasma step, with a gas flow rate of about 10-500 standard cubic centimeters per minute (sccm; col 3, lines 23-40), a chamber pressure about 20 milliTorr to about 1Torr (col 3, lines 9-22), a chamber temperature of about 25 to 150 degree C, a RF power ranging of about 50-400 Watts, and for a period of about 5-60 seconds (col 4, lines 1-5, 51-60).

Therefore, the subject matter as a whole would have been obvious to one or ordinary skill in the art at the time the invention was made to select the portion of the prior art's range flow rate, temperature, a RF power ranging for top RF power and bias RF power, pressure, time period, etc., as taught by Yeh and Webb, and known in the art, which is within the range of applicant's claims, because it has been held to be obvious to select a value in a known range by optimization for the best results, and would be an unpatentable modification, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation". *In Re Aller* 104 USPQ 233,255 (CCPA 1955); *In re Waite* 77 USPQ 586 (CCPA 1948); *In Re Swanson* 56 USPQ 372 (CCPA 1942); *In Re Sola* 25 USPQ 433 (CCPA 1935); and *In Re Dreyfus* 24 USPQ 52 (CCPA 1934).

6. Claims 9-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al (6,025,273), Yeh et al (6,207,565) and Yang et al (6,221,772), as applied to claims 1,5 above, taken with Verhaverbeke et al (2003/0045098).

The references including Chen, Yeh and Yang teach an integrated process flow involving a patterned photoresist layer 18 as applied to claims 1 and 5 above.

The references including Chen already teaches using the patterned photoresist layer 18 during semiconductor fabrication, wherein, the opening exposes an underlying silicon layer 12 and step (c) forms a shallow trench in the silicon layer 12 (Figs 7,5; col 5, lines 1-49).

Chen thus lacks mentioning his method for forming a shallow trench in the substrate (claim 9); and for forming a gate electrode (claim 10).

However, Verhaverbeke teaches (at Figs 16A-16C) applying the method for forming a shallow trench in the substrate (claim 9), wherein the method is also applied (at Figs 15A-15E) for forming a gate electrode (claim 10).

Therefore, it would have been obvious to one or ordinary skill in the art at the time the invention was made to apply the method of Chen for removing residues during the formation of a shallow trench in the substrate and during the formation of a gate electrode, as taught by Verhaverbeke. This is because of the desirability to eliminate unwanted residues from the substrate so that a high quality integrated device can be manufactured in a reliable manner.

Response to Amendment

7. Applicant's remarks filed October 30, 2006 have been fully considered but they are moot in view of the new ground(s) of rejection.

** It is noted Applicant assertedly alleged that "THE TEACHINGS FROM THE BACKGROUND ARE NOT ADMITTED PRIOR ART" and "...the paragraph bridging pages 1-2..." is not "prior art".

The references including Yeh and Yang teach using the same plasma chamber for performing a number of steps including oxygen plasma ashing and plasma etching.
Yeh clearly teaches (at Table I, Figure 6, col 6, lines 38 through col 7; Fig 9; col 2, lines 38-54; col 1, lines 35-53) that the same process chamber (e.g. the inductively-coupled plasma chamber) is used for performing and carrying out these steps, in which Yeh teaches after performing an oxyen plasma ashing to remove the photoresist, performing a halogen plasma etching step to clean residue, and performing a plasma etching to the cleaned opening, wherein the same single inductively-coupled plasma chamber is used for ashing and etching. Therefore, the combined references clearly establish a prima facie case of obivouness with reasonable expectation of success to perform and carry out these plasma ashing and plasma etching by using the same plasma chamber. This is at least because of the desirability to reduce production and equipment cost since only the same single inductively-coupled plasma chamber of the Mattson Aspen ashing system, and because of the desirability to allow a number of steps to be performed in the same plasma chamber, less expensive, wherein manufacturing of an electronic device is simpler since only a single tool is needed for performing a number of steps.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael M. Trinh whose telephone number is (571) 272-1847. The examiner can normally be reached on M-F: 9:00 Am to 5:30 Pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Zandra Smith can be reached on (571) 272-2429. The central fax phone number is (703) 872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).
Oacs-9

Michael Trinh
Primary Examiner